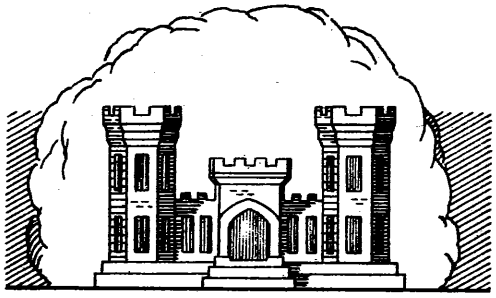
THE CAPE COD CANAL

AND OTHER PROJECTS

IN THE

BOSTON U. S. ENGINEER DISTRICT

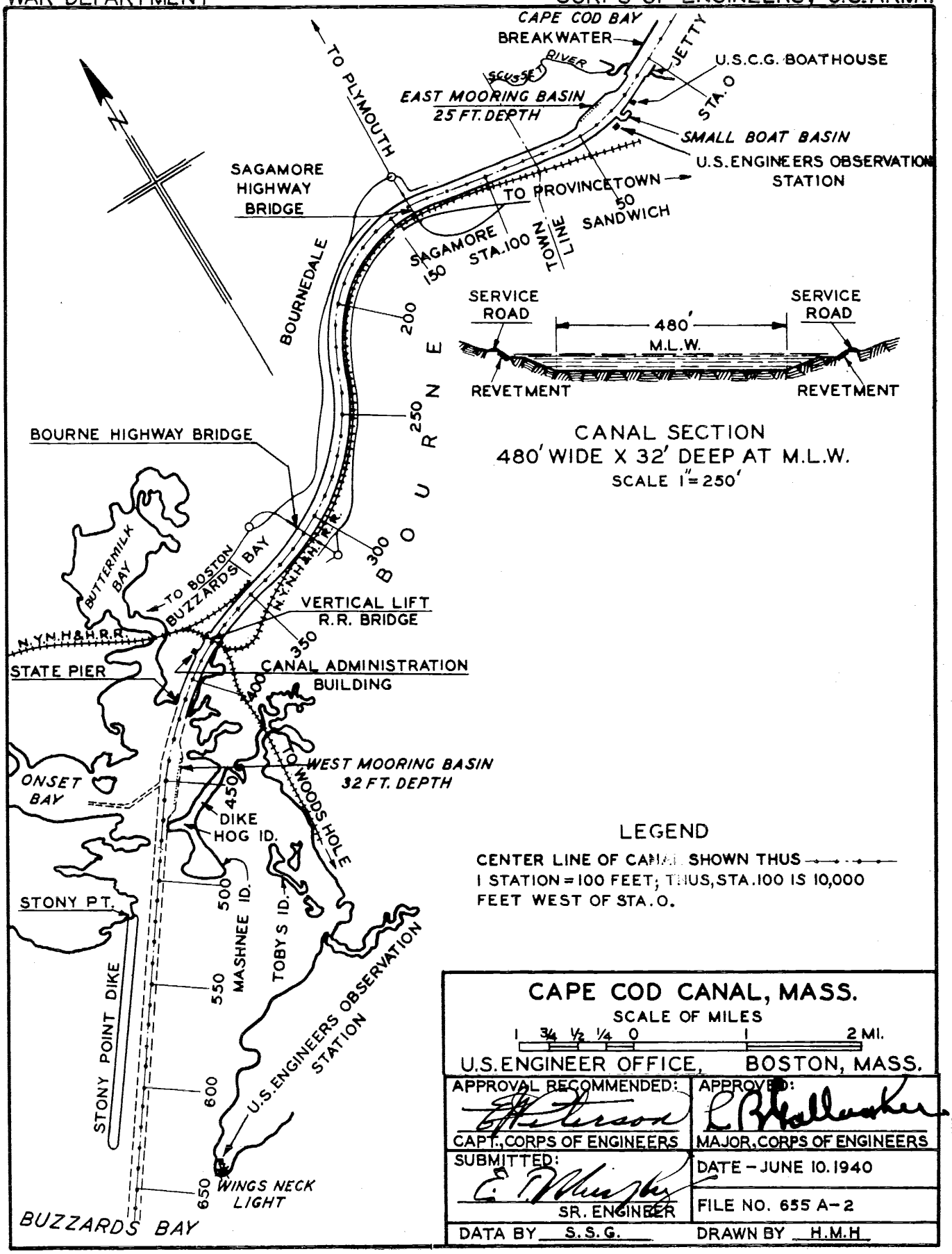
1940



CORPS OF ENGINEERS, U. S. ARMY

U. S. ENGINEER OFFICE BOSTON, MASS.

WAR DEPARTMENT CORPS OF ENGINEERS, U.S.ARMY.



LEGEND

CENTER LINE OF CANAL SHOWN THUS ——·——·——
1 STATION = 100 FEET; THUS, STA. 100 IS 10,000 FEET WEST OF STA. O.

CAPE COD CANAL, MASS.

SCALE OF MILES

1 3/4 1/2 1/4 0 1 2 MI.

U.S. ENGINEER OFFICE, BOSTON, MASS.

APPROVAL RECOMMENDED: G. Peterson CAPT., CORPS OF ENGINEERS	APPROVED: L. B. Wallace MAJOR, CORPS OF ENGINEERS
SUBMITTED: E. T. Murphy SR. ENGINEER	DATE – JUNE 10. 1940
	FILE NO. 655 A–2
DATA BY S.S.G.	DRAWN BY H.M.H

THE CAPE COD CANAL

The Cape Cod Canal is now the widest artificial waterway in the world. Within the past ten years it has been transformed under the supervision of the Army Engineers from a narrow, shallow, inadequate and dangerous waterway into one which is entirely capable of fulfilling its economic function of providing a safe shorter route for coastwise vessels.

History.

So much has been written and said about the Cape Cod Canal over such a long period of time that many people believe it is a very old canal, but it was actually opened to traffic in 1914. It is true that proposals for a Cape Cod Canal date back to Colonial times when Myles Standish first traversed, in 1623, the route by boat and on foot to meet a group of Dutchmen from New Amsterdam. In the following year it became an established trade route and in 1627 the Aptucxet Trading Post at Bourne was built to provide a meeting place for the Dutch and Pilgrim traders. This building is an interesting landmark which has been restored by the Bourne Historical Society.

Before construction of the Cape Cod Canal started in earnest in 1909, so many surveys had been made that the late Senator McCall once remarked that "Every grain of sand along the proposed route has been made the victim of an algebraic equation".

The canal opened in 1914 was built by the Boston, Cape Cod, and New York Canal Company, with which Mr. August Belmont, the famous financier, and General William Barclay Parsons, the eminent engineer, were prominently identified. Several bad accidents to shipping occurred in this canal as a result of which it was looked upon with disfavor by many mariners. Consequently, the returns from the tolls charged did not come up to the rather optimistic expectations of the promoters and efforts were soon commenced to sell the canal to the Government. Purchase by the Government was not consummated, however, until 1928 and then only after exhaustive studies directed by Congress to determine the justifiability of Government ownership.

Purchase by Government.

Congress authorized the purchase of the Cape Cod Canal in the full knowledge that expensive improvements were necessary if it was to be made a usable waterway. Consequently, as soon as the canal came into the possession of the Government and was assigned to the jurisdiction of the Army Engineers, they began to make studies of plans for improvement.

When the canal was purchased by the Government it had a project depth of 25 feet, bottom width of 100 feet, and was crossed by 3 narrow drawbridges: Highway bridges at Sagamore and Bourne and a railway bridge at Buzzards Bay. Prior to the period of Federal ownership, vessels using the waterway were required to pay a toll varying, according to the type of vessel, from 3 cents

to more than 10 cents per gross ton. Since March 1928, however, the canal has been operated by the Government as a toll free waterway, with a resultant increase in the traffic.

Improvement Program.

No work of improvement other than maintenance dredging was performed during the first 3 years of Government ownership and operation. In December 1933 an extensive improvement program was begun when the construction of 3 new bridges was initiated. The adopted improvement program provides for a sea level canal 32 feet deep at mean low water with a width of 540 feet in the land cut, 500 feet in a straight channel in Buzzards Bay to Wings Neck, and 700 feet beyond Wings Neck; a harbor of refuge for small vessels by dredging a channel 15 feet deep and 100 feet wide to Onset Bay; mooring basins; the construction of two high level fixed highway bridges having a horizontal clearance of 550 feet between the main piers with a vertical clearance at mean high water of 135 feet; the construction of a railroad bridge with a vertical lift of 500-foot span and 135 feet vertical clearance when the span is raised; an improved lighting system, and other accessory and minor features approved by the Chief of Engineers. Work on this improvement program has now been completed except that berms have been left on each side of the channel, reducing the bottom width to 480 feet.

Tides and Currents.

The total length of the Cape Cod Canal, including approach channels, is 18 miles. The channel in the land cut is 7.0 miles long. The mean range of tide in Cape Cod Bay is 9.4 feet, in Buzzards Bay 4.0 feet. In addition to differing in range, the tides of these two bays differ in phase, high tide in Buzzards Bay preceding high tide in Cape Cod Bay by approximately 3 hours. As a result of these tidal conditions, the currents in the canal change direction every 6 hours and reach an average maximum velocity of 4 knots. The effect of these tidal phenomena on the enlarged canal of 540-foot width and 32-foot depth has been studied with the aid of a model 115 feet in length constructed at the River Hydraulics Laboratory of the Massachusetts Institute of Technology under the supervision of Dr. K. C. Reynolds.

Dry Excavation and Revetment.

The land through which the canal passes is composed principally of sand, although gravel, cobbles and boulders are also present. Much of the sand is fine and capable of being moved by tidal currents and the surface waves caused by wind and the passage of vessels. To preserve and protect the bank slopes and alignment of the sides of the canal from the wave wash, revetment 2 feet thick, composed of riprap and crushed stone, and extending from 5 feet below low water to 5 feet above high water, has been placed on both banks for the whole length of the canal. The revetment work was done largely in the dry, prior to widening the canal by dredging. To prevent erosion of the surfaces of the exposed banks and cuts along the canal by wind and rain, the upper slopes have been loamed and seeded with grasses whose roots now hold the surfaces of the slopes intact.

Construction Features.

In accordance with the policy of the Army Engineers, most of the construction work for the improvement program recently completed was done by contract. In addition to the construction of the 3 large bridges previously mentioned, the project required contracts for dry excavation and revetment, relocation of highways and a railroad, demolition of several acres of industrial buildings, demolition of 3 old bridges, construction of service roads, an administration building, a steel sheet pile bulkhead, and last, but by no means least, a large amount of dredging. The contractors employed the most modern types of equipment, ranging in size from bulldozers, draglines, power shovels, trucks, scrapers and other special earth moving vehicles, to dredges which rank in size and power with the most powerful dredges in the world.

Cost.

The total cost of the improvements has been about $20,000,000, exclusive of $11,500,000, the purchase price of the canal. The total cost of permanent work, comprising new work and maintenance to date has been approximately $37,000,000. The magnitude of the project is indicated by the fact that, including excavation for the original canal, a total of about 54,000,000 cubic yards of material has been removed from the canal. This great volume of material would completely fill 250 buildings the size of the Park Square Building of Boston or would fill more freight cars than could be placed on a 2-track railroad line between Boston and San Francisco.

Commerce.

Although the improvement has not yet been completed long enough for commerce to reach the peak to be expected a little later, the commerce using the canal is constantly growing in volume. Each month, the increase in value of this important link in the intracoastal waterway from Maine to Florida is more evident. Practically all coastwise vessels clearing from or consigned to northern New England harbors are now using this waterway, with the exception of the largest freighters and tankers. From 1928 to 1939, the number of vessels using the canal increased more than 50 percent. Vessels in 1928 had an average net registered tonnage of 440; in 1939, 907; an increase of over 100 percent. Both the general trend toward the use of larger vessels and the canal improvement program have contributed toward the increase in tonnage. General cargo (2,455,740 tons), petroleum products (1,172,837 tons) and coal (814,994 tons) represented 49, 23, and 16 percent, respectively, of the freight traffic during 1939. About 21 percent of the general cargo was in tramp steamers or motor vessels in foreign trade and the remainder mostly in domestic passenger-and-freight business between New York and Boston. Savings of distance, fuel, and time, more reliable shipping schedules, and other incidental benefits made available to practically all coastwise intracoastal shipping serving New England make the expenditure for the improvement program economically justified.

National Defense.

The improved canal will also have an important function in the scheme of national defense which is difficult to evaluate in dollars and cents. The canal is of strategic importance to the Navy, not only directly through security afforded naval vessels, but also indirectly through security afforded the merchant marine. The inadequacy of the original canal in this respect was strikingly illustrated during the World War when an enemy submarine, operating off Cape Cod, caused so many ships to seek safe passage through the canal that traffic was tied up for days.

Supervision.

Major Leonard B. Gallagher, Corps of Engineers, U. S. Army, as District Engineer of the Boston U. S. Engineer District, also has under his jurisdiction numerous other projects. The Boston U. S. Engineer District comprises the states of Maine, New Hampshire and Massachusetts, exclusive of that part of those states contained in the Connecticut River watershed. The Cape Cod Canal, Boston Harbor and flood control projects in the Merrimack River Basin are now the major active projects in this district.

BOSTON HARBOR, MASS.

History.

Nature was unusually kind to Boston Harbor when she laid out its shore line, approaches, and navigable tributary streams, but she provided a natural depth of only 23 feet. Early commerce from the time of the Pilgrims until the year 1866 found the 23-foot depth ample for all requirements, but with the increase in draft of vessels, Boston, like many other ports, found itself in a position of being no longer able to accommodate large ocean vessels. Since 1866 there have been progressive improvements in the alignment of the channel in Boston and provision made for increasing the depth, first to 27 feet, and later to 35 feet.

40-Foot Channel.

In recent years, authorization for a 40-foot depth has been secured, which provides for a channel 40 feet deep at mean low water, extending from the harbor entrance to the piers used by trans-Atlantic shipping. In addition, it provides for a large anchorage area in President Roads. Work on the 40-foot channel was commenced in the spring of 1936 and will be completed next year. The difficulty of prosecuting the work on the 40-foot channel was enhanced by large rock formations which were encountered at the bottom. Dredging the rock areas has necessarily been very slow as this work must be prosecuted with due regard for shipping and the safety of the piers and wharves in the harbor.

Commerce.

Upon the completion of work now in progress approximately $18,000,000 will have been spent for new work of improving the channel in the harbor.

This expenditure is fully justified economically. Boston Harbor is the second port in the United States in terms of volume of imports for consumption and is second only to New York in volume of ocean-going passenger traffic. In 1938 over 15,880,767 tons of commerce passed through this port.

FLOOD CONTROL

Investigations.

Following the unprecedented floods of 1936, which caused such disastrous damage in New England, the Congress of the United States authorized extensive investigations by the Engineer Department, with a view to providing flood control on the major rivers of the country. In the Boston U. S. Engineer District, extensive studies were conducted on the Merrimack, Kennebec, Penobscot, Androscoggin, Saco and Salmon Falls Rivers and their tributaries, totaling a length of more than 2,000 miles, with drainage areas aggregating 25,000 square miles. In addition to flood control, it was the expressed intention of Congress that the studies should include consideration of navigation, irrigation and power. More than 300 men were engaged on these studies and investigations.

On all of the river studies, control of floods by means of reservoirs was, in general, indicated as the most desirable method. Local flood protection projects, such as channel improvements, levees, or flood walls, are, in some cases, required to supplement the protection afforded by a reservoir system or to provide protection for localities unaffected by the reservoir system.

Projects.

Local flood protection projects at Fitchburg, Lowell, and Haverhill, Massachusetts, have been constructed by the Boston Engineer District with relief funds at a total cost of approximately $4,000,000.

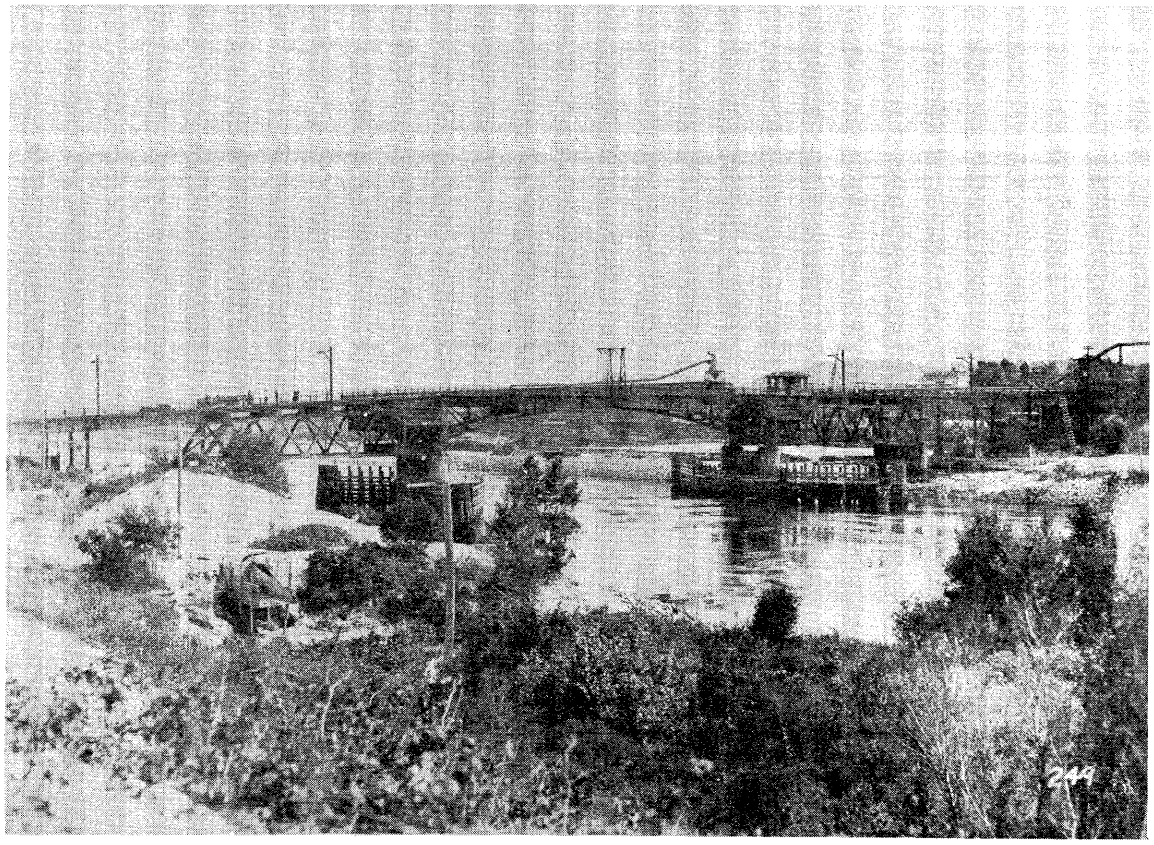
Construction of reservoirs in the Merrimack River Basin was authorized by the Flood Control Acts of June 22, 1936 and June 28, 1938. The complete reservoir system authorized will cost, it is estimated, more than $20,000,000. Work on two of the dams for this reservoir system, the Franklin Falls Dam and the Blackwater Dam, has been started.

Franklin Falls Reservoir.

The site of the Franklin Falls Dam is located on the Pemigewasset River, the main tributary of the Merrimack River, about 2-1/2 miles above Franklin, New Hampshire, and 92 miles north of Boston, Massachusetts. The dam will be of rolled earth fill with dumped rock shell and toe, 1,740 feet long, with a maximum height of 136 feet. It will contain about 3,000,000 cubic yards of earth and rock fill. A 550-foot spillway and 810 square feet of gate-controlled outlet conduits involving 76,000 cubic yards of concrete will be constructed in open cut rock. The total estimated cost of the Franklin Falls Reservoir is about $8,000,000.

Blackwater Reservoir.

The site of the Blackwater Dam is located on the Blackwater River near Swett's Mills, New Hampshire, about 11 miles from the Franklin Falls Dam. The dam will be of rolled earth fill 750 feet long, with a maximum height of 60 feet. It will contain about 200,000 cubic yards of earth and rock fill. A 240-foot spillway, outlet works consisting of 4 rectangular conduits through the spillway, a penstock intake for a 16-foot penstock, and a concrete non-overflow section connecting the penstock intake and the dam embankment, all involving 22,000 cubic yards of concrete, will be constructed on open cut rock. The total estimated cost of the Blackwater Reservoir is about $1,300,000.



OLD SAGAMORE HIGHWAY BRIDGE AUGUST 1922

NEW SAGAMORE HIGHWAY BRIDGE JUNE 1940